Advancing Canadian Housing Technology: A Report of IRC Housing Activities Prepared for the Canadian Home Builders' Association

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Advancing Canadian Housing Technology

A Report of IRC Housing Activities Prepared for the Canadian Home Builders' Association

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The Institute for Research in Construction (IRC), part of the National Research Council of Canada, is the leading provider of research and technology services for the construction industry in Canada.

IRC’s research, involving collaborators from Canada and around the world, focuses on four programs:

- the building envelope and structure
- the indoor environment
- fire risk management
- urban infrastructure rehabilitation.

Two complementary national services are IRC’s leadership role in the development of Canada’s model construction codes, and its program for the evaluation of innovative construction products. Technology transfer is carried out through a national newsletter, practice publications, nationwide seminars, and a comprehensive website.

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INTRODUCING IRC

Canada is a world leader in the provision of comfortable, safe and affordable housing. The Institute for Research in Construction (IRC), in consultation and cooperation with the Canadian Home Builders’ Association, devotes a substantial portion of its construction technology and innovation resources to issues that directly affect residential construction and the members of CHBA.

IRC is an active member of the CHBA Technical Research Committee and considers this committee an indispensable means of remaining informed about housing industry issues and disseminating the results of IRC’s work. This annual report to the CHBA supplements the on-going participation of IRC.

IRC also encourages individual CHBA members to stay abreast of its housing-related work through IRC’s technology transfer activities. These are described at the end of this report.

The work of each of the six IRC centres of expertise benefits home builders:

- **Canadian Codes Centre:** This group is responsible for developing and maintaining Canada’s National Construction Codes, which provide a consistent and logical regulatory framework for the Canadian housing industry.

- **Canadian Construction Materials Centre:** Home builders, construction product manufacturers, regulators and design professionals rely on CCMC to provide objective, scientifically based evaluations of innovative materials, products, systems, and services.

- **Building Envelope and Structure:** This research group is Canada’s leading authority on building-envelope performance, developing and disseminating information and guidelines on the design, construction and operation of durable, energy-efficient and cost-effective building envelopes.

- **Indoor Environment:** IRC studies the key elements of indoor environments—lighting, acoustics, temperature, ventilation and air quality—and how they, singly and in combination, affect occupant satisfaction and comfort.

- **Fire Risk Management:** The goal of fire research at IRC is to reduce the risks and costs associated with fire. This group has made significant advances in the understanding of how these risks can be efficiently and economically managed in Canadian housing.

- **Urban Infrastructure Rehabilitation:** The work of this group has a positive affect for home builders because it has a direct affect on keeping the costs of subdivision servicing in check.

The achievements of IRC are to a large extent based on collaboration with industry partners such as the Canadian Home Builders’ Association.

This report describes briefly the housing-related activities currently underway at IRC. For more information, contact the project managers listed in the project reports. (For e-mail, all IRC staff members use an e-mail address that follows this model: firstname.lastname@nrc.ca).
NATIONAL CONSTRUCTION CODES

(Canadian Codes Centre)

IRC’s Canadian Codes Centre plays a vital role in this process by providing technical and administrative support to the Canadian Commission on Building and Fire Codes (CCBFC) and its related committees, which are responsible for the development of the national model construction codes of Canada.

IRC, through the Codes Centre, ensures that the best available knowledge from across Canada and around the world is brought to bear on the review, updating and advancement of the national codes, enhancing Canada’s position as a world leader in the development of comprehensive, yet practical, regulatory instruments.

Standing Committee on Houses

The Standing Committee on Houses is responsible for the technical content of Part 9, Housing and Small Buildings, of the National Building Code. Home builders are well represented on the Standing Committee by Richard Lind, John Carroll and Peter Aitcheson. Don Johnston, CHBA’s Senior Director, Policy and Technology, is an ex-officio, non-voting member of the Committee.

In October of 2002, the Canadian Commission on Building and Fire Codes, in cooperation with the provinces and territories, will conduct public consultation on technical changes to both the national codes and provincial codes. It will be the first ever coordinated national/provincial/territorial consultation on technical changes. In preparation, the Standing Committee on Houses has prepared a large number of proposed changes to Part 9 of the National Building Code.

As part of the new integrated national/provincial/territorial code development and maintenance system, these changes will first be reviewed by the provinces and territories prior to the public consultation. Thus it is possible that some of the proposed changes described in the following sections will not reach public consultation if the provinces and territories have reservations about them and ask the Standing Committee to re-consider.

Stairs, Handrails and Guards

A task group produced a package of proposed changes in this area, including a number of relaxations of requirements (e.g., two sets of winders in a flight, 45° winders, combined straight and curved stairs in a flight) and a few increases in stringency (e.g., minimum run increased from 210 mm (8¼ in.) to 230 mm (9 in.), an increase in minimum headroom). Doug Wortman and Wayne Cole from Ontario and Don Wopnford from Alberta represent the home building industry on the task group.

The Standing Committee could not agree on the stair dimensional changes (e.g., minimum run, headroom) and asked the task group to continue to study the issue; this means these changes will not be considered for the next edition of the National Building Code but will have to wait for a subsequent edition. However, the Standing Committee agreed to most of the other changes recommended by the task group.

Ventilation

A Task Group has been working to improve the mechanical ventilation requirements in Section 9.32. due to the difficulty the housing industry was having in meeting the requirements.

John Carroll from Saskatchewan, Greg Redden from Nova Scotia and Tom Keating from Ontario represent the home building industry on the task group.

At the request of the Standing Committee, the task group developed some proposed changes to the prescriptive mechanical ventilation requirements in Section 9.32. The Standing Committee agreed to these changes. The proposed revised version of Section 9.32 includes the following changes:
• The outdoor air duct to a forced air heating system must incorporate both an adjustable damper and a mechanical damper. The airflow in the duct must be measured and the damper adjusted to ensure that excess cold air does not flow over the furnace heat exchanger. The mechanical damper must only open when the principal ventilation fan is operating.

• If spillage-susceptible combustion equipment is present, all exhaust devices other than the principal ventilation fan (e.g., bathroom and kitchen exhaust fans) must be linked to make-up air fans of the same capacity.

• If no spillage-susceptible combustion equipment is present, an exhaust-only ventilation system can be used. The dwelling must incorporate a forced air heating system or similar air circulating system linked to the principal ventilation fan to ensure that the outdoor air drawn in through the building envelope (the only source of outdoor air in such a system) is circulated evenly throughout the dwelling.

• If the mechanical ventilation system is one that can lead to depressurization of the dwelling, and the dwelling contains combustion equipment or an attached garage, the dwelling must include carbon monoxide detectors in various locations.

• The alternative of designing the ventilation system to comply with CSA Standard F326 continues to be available.

**Carbon Monoxide Detectors**

In addition to the CO detector requirement mentioned above, an alternate, more comprehensive CO detector requirement will be part of the public consultation package. In this proposed change, CO detectors would be required in any dwelling that incorporates any form of combustion equipment or an attached garage, regardless of the configuration of the ventilation system. A similar change is proposed to Part 6 of the NBC and thus would apply to all residential buildings, regardless of size.

**Lateral Load Resistance of Part 9 Buildings**

Lateral load resistance is often overlooked in the design of Part 9 buildings because many Part 9 buildings, especially houses, have a lot of inherent lateral load resistance. However, larger houses with non-traditional configurations (e.g., open floor plan, two-storey high rooms) are becoming more common and this raises the question of whether this aspect of building design can continue to be overlooked. Changes proposed for Part 9 would define configurations (combinations of braced walls and openings) where lateral load analysis will be required.

In a few areas with high seismic loads (mainly in south coastal British Columbia), or very high wind loads (e.g., Pincher Creek AB, Harrington Harbour PQ, Cape Race NF) lateral load analysis would be required regardless of building configuration.

**Snow Loads**

The simplified approach to calculation of snow loads in Part 9 is currently restricted to wood-frame construction. The Canadian Commission on Building and Fire Codes will extend this simplified approach to structures of any material that share the high degree of structural redundancy created by the closely-spaced, repetitive members of frame construction. This will be published by the time of the 2002 CHBA Annual Conference.

Failure of roofs from snow loading is the most common type of structural failure in Canada – generally in larger, non-Part 9 buildings. For this reason, the Standing Committee on Structural Design is proposing that the ground snow loads in Appendix C be changed from a 1 in 30 year return period to a 1 in 50 year return period. This would result in an increase in ground snow loads and thus roof snow loads of about 10%. However, failure of Part 9 roofs under snow is far less common so it is difficult to justify even a 10% increase in snow loads for Part 9 buildings. Therefore it is proposed to continue to include the 1 in 30 ground snow loads in Appendix C (in addition to the 1 in 50 loads) for use with Part 9.
Keeping the Rain Out

A proposal submitted by the Province of Nova Scotia (at the urging of the Nova Scotia Home Builders’ Association) requested that the National Building Code require a vented air space behind cladding. This request prompted the development of an extensive set of proposed requirements relating to the resistance of walls to precipitation ingress.

In some situations, there would be a requirement that a wall incorporate two planes of defence against precipitation ingress and, in a subset of those situations, there would be a requirement that the two planes of defence be separated by a capillary break. Normal vinyl or metal siding placed over sheathing paper would satisfy both of these requirements by virtue of the vented spaces behind the siding.

In order to differentiate locations where the more stringent requirements would apply, a new climatic indicator – the moisture index – would be added to the table of climatic data in Appendix C. The index is a single number that reflects both the amount of rainfall that the location receives and the duration of drying periods. It is based on research conducted as part of IRC’s Moisture in Exterior Wall Systems (MEWS) project. As one might expect, coastal areas will tend to have high moisture indices and prairie areas will tend to have low moisture indices.

Spatial Separation

Subsection 9.10.14 on spatial separations has been modified and adjusted over many years to such an extent that it is now one of the most complicated and difficult to understand parts of Part 9. Extensive reorganization and clarification (without actually changing the requirements) is proposed to make this subsection easier to use.

Other Proposed Changes

The following changes will also be discussed in the public consultation process:

- specific provisions for insulated concrete forms (ICF)
- windows large enough to be used for emergency egress in basements even if there is no bedroom in the basement
- higher masonry foundation walls for a given thickness when the masonry incorporates reinforcing
- loose fill insulation permitted in basement walls
  (A “special change” permitting loose fill insulation on ceilings sloped up to 4.5 in 12 has been approved by the Commission and will be published by the time of the 2002 CHBA Annual Conference.)
- clarification of how current foundation requirements apply to decks
**Objective-Based Codes**

Based on the results of the public consultation held during 2000/2001, the Canadian Commission on Building and Fire Codes has reached final decisions on the objectives that will form the basis of the National Construction Codes (some provincial building codes address additional objectives). Subject to ratification by the provinces and territories, the objectives of the National Building Code are as follows:

<table>
<thead>
<tr>
<th>Safety</th>
<th>Health</th>
<th>Accessibility</th>
<th>Fire &amp; Structural Protection of Buildings</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Fire safety</td>
<td>• Indoor conditions</td>
<td>• Barrier-free path of travel</td>
<td>• Protection of the building from fire</td>
</tr>
<tr>
<td>• Structural safety</td>
<td>• Sanitation</td>
<td>• Barrier-free facilities</td>
<td>• Protection of the building from structural insufficiency</td>
</tr>
<tr>
<td>• Safety in use</td>
<td>• Noise protection</td>
<td></td>
<td>• Protection of adjacent buildings from fire</td>
</tr>
<tr>
<td>• Resistance to unwanted entry</td>
<td>• Protection from unacceptable vibration or deflection</td>
<td></td>
<td>• Protection of adjacent buildings from structural damage</td>
</tr>
<tr>
<td></td>
<td>• Containment of hazardous substances</td>
<td></td>
<td></td>
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</tbody>
</table>

Detailed definitions of these objectives and sub-objectives can be found on the Commission’s web site at www.ccbfc.ca.

CHBA members may recall that these objectives were derived from a detailed analysis of the requirements of the current versions of the various codes. That same analysis also produced a detailed statement of the intent of every requirement in the codes. After extensive revision of these intent statements by an external consultant and Codes Centre staff to achieve a high degree of consistency in language and logic, these intent statements are now being posted on the Commission’s web site for review by code users. Eventually they will be published as user guides for the codes.

The objectives and intent statements, together with the existing code requirements, form the raw material from which the objective-based codes will be forged. Under the guidance of the recently formed Task Group on Drafting of Objective-Based Codes, Canadian Codes Centre staff will develop objective-based versions of the 1995 codes. These will be available for public review at the same time as the proposed technical changes to the codes; i.e. beginning in October 2002. Code users will have the opportunity to assess the overall workability of the objective-based format and point out any areas where code provisions have been inadvertently changed by the change in format.

The October 2002 public consultations were originally planned for the Spring of 2002. However, the Commission, again in consultation with the provinces and territories, decided that more time is needed to properly prepare for this consultation. This will have the effect of delaying publication of the next editions of the National Construction Codes from late 2003 until Spring 2004.

For more information, contact John Haysom (613-993-0043).
EVALUATING CONSTRUCTION PRODUCTS AND SYSTEMS

The Canadian Construction Materials Centre (CCMC) offers a national product evaluation service, giving home builders and the construction industry access to evaluations based on solid technical criteria and rigorous testing. The result is an impartial, knowledgeable judgment on a product’s suitability for its intended use, based on whether it meets the intent of codes and standards.

CCMC Registry of Product Evaluations Now Online

The Registry of Product Evaluations, published by CCMC, contains detailed references for more than 500 evaluated products, all classified numerically according to the 16-division North American MasterFormat system.

CCMC has published the 2001 edition of the Registry of Product Evaluations and makes the evaluations available on the web site. The web site version is updated quarterly – thus providing home builders with faster access to new evaluations. Nearly 10,000 users rely on the Registry for the latest information on new building products.

To obtain a free subscription to the annual printed volume, contact IRC Client Services (tel. 800-672-7990; fax 613-952-7673). For the electronic version, visit the web site at (http://www.nrc.ca/ccmc/prodevalues_e.shtml).

Joist Hangers

IRC initiated a consortium project to develop information to allow joist hangers to be evaluated against the limit states design requirements of the National Building Code (NBC). This work resulted in the publication of a CCMC technical guide that provides evaluation procedures for joist hangers.

Since the Guide’s completion in 1995, CCMC has conducted three evaluations on joist hangers, and new ones are underway. The evaluated products meet the criteria established in the CCMC Guide and CSA O86.1, and they are also deemed to meet the requirements of NBC Part 4 and/or Part 9 as applicable.

The evaluation reports are available in the CCMC Registry of Product Evaluations under MasterFormat division 06094.

For additional information, contact Caroline St-Onge (613-998-4625).

Steel Framing for House Construction

CCMC, in partnership with the Canadian Sheet Steel Building Institute (CSSBI), is making it easier to construct steel-frame housing and small buildings. This is being achieved through a technical guide that allows light steel-frame (LSF) floor and wall assemblies to be used in a Part 9 building without requiring further on-site engineering. CCMC and CSSBI are now updating these requirements to include roof rafters.

The technical guide addresses performance criteria for heat transfer, air leakage, condensation control and structural performance, including vibration criteria for floor joists. From the technical guide, CSSBI has developed construction requirements for steel studs and joists equivalent to those in Part 9, and incorporated them into the CSSBI Installation Manual (which shows how LSF products combine to form a complete building system) and member selection tables. CSSBI has also developed a quality assurance manual for the manufacture of LSF members.

Each light steel-frame manufacturer will have its product evaluated against these requirements to determine compliance with NBC Part 9, thus allowing it to market its products as meeting the required standards. To date, three proponents have completed the evaluation, and another two evaluations are in progress.

Please contact Alphonse Caouette (613-993-6917) for further information.
Canadian Housing Technology in Russia

A letter of agreement has been signed between the Canadian Construction Materials Centre and Gosstroy, the Russian agency that regulates construction and materials. Although not all Canadian home builders will be interested in work overseas, this arrangement will create favourable conditions for product manufacturers and for those builders who are interested in capitalizing on the enormous potential of Canadian housing technology in Russia.

Questions may be directed to Luc Cécire (613-993-0776).

Evaluating Residential Wastewater Treatment Technologies

CCMC has received requests to evaluate wastewater treatment systems. These on-site modular technologies treat and dispose of wastewater from single-family residential buildings, clustered subdivisions, and commercial and industrial applications. They are used in conjunction with conventional septic tank treatment systems and disposal fields.

For information about such evaluations, please contact Harry Baker (613-993-3807).

Auger-Installed Steel Piles

CCMC has created a technical guide that describes the technical requirements and performance criteria for the assessment of auger-installed steel piles for the purpose of obtaining a CCMC Evaluation Report. These piles are also referred to as screw piles, screw mandrills or helical anchors. They are used as a foundation system to support various building constructions such as decks, sunrooms, carports, cottages and storage sheds.

The auger-installed steel piles are earth anchors constructed of helical-shaped, circular steel plates welded to a steel shaft. These anchors are screwed into the ground using mechanized equipment until the appropriate bearing stratum is reached or until the applied torque value attains a specified value. The applied loads may be tensile (uplift), compressive (bearing), shear (lateral), or some combination. Helical anchors are rapidly installed in a wide variety of soil formations using several common types of equipment. The piles are immediately ready for loading after installation.

The auger-installed steel piles under evaluation will need to conform to a set of performance and prescriptive requirements equivalent to those in Part 9 of the National Building Code. The requirements cover issues such as structural performance, as well as evaluating the methods used to assess the bearing capacity on site and the installation techniques. The foundation system will also be evaluated as an anchorage against overturning and uplift forces.

For more information, contact Alphonse Caouette (613) 993-6917.

Engineered Wood Joists – Vibration Criteria

At a joint Canadian Wood Council/CCMC/Forintek meeting in May 2000, the engineered wood joist industry confirmed that the current vibration criteria do not result in adequate performance for all classes of floors. Since then, all engineered joist manufacturers (some were not in attendance at the meeting) have been informed of the shortcoming of the vibration criteria in cases where concrete topping is used or bridge/blocking is used and spans are installed at the maximum.

At the CSA O86 Proprietary Products Subcommittee meeting in November 2001, the engineered wood joist industry supported the inclusion of a note identifying this shortcoming within their respective CCMC reports. This note will remain within the CCMC Reports until the new vibration ‘dynamic’ criteria developed by Forintek are finalized. Currently a task group led by Dr. Chui of the University of New Brunswick is working with the engineered wood industry to review the impact of the new criteria with a target to finalize the approach in 2002.

For more information, contact Bruno Di Lenardo at 993-7769.
BUILDING ENVELOPE AND STRUCTURE

Durability, energy-efficiency and cost-effectiveness: today’s building systems must meet these three key objectives. Whether the end-use is in new construction, repair or renovation, IRC develops technologies for the design, construction and operation of building envelope systems that meet those objectives.

Failure to control moisture, heat loss and air leakage causes billions of dollars in damage annually to building envelopes in North America, wastes energy and creates unfavourable indoor conditions – all possible problem areas for home builders. IRC’s laboratory and field studies focus on developing a better understanding of the transport of heat, air and moisture through the building envelope in order to provide better information to home builders with regard to materials and systems.

Guidelines for Basement Envelope Systems

The high frequency of basement-related claims made under new home warranty programs led IRC several years ago to secure the support of some key industry partners to carry out a number of research projects to study the performance of basement insulation systems. Some key results of the basement study have already been reported in Construction Technology Update No. 36, *Performance of Insulation Applied to the Exterior of House Basements*, which showed that expanded polystyrene (EPS) insulation, both Type I and Type II, spray polyurethane foam (SPF) insulation, glass fibre (GF) and mineral fibre (MF) insulation systems all maintained their thermal performance over two years in the ground and protected the basement structure at the same time. A change to Part 9 of the National Building Code in November 1999 now permits EPS Type I to be used on the exterior of basements.

The main research work has been completed and four chapters dealing with performance requirements, system selection, material and equipment selection, and design details are now being reviewed by the Steering Committee. The final draft will be completed by spring 2002.

For more information, contact Mike Swinton (613-993-9708).

Building Material Performance Report

IRC completed this project with the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) in 2000. The result is an “outcome” database, which deals with the properties that determine the performance of all common building materials in North America. It should prove very useful for builders interested in assessing or comparing the potential performance of various building materials. The final report, titled *A Thermal and Moisture Transport Property Database for Common Building and Insulating Materials*, is now being reviewed by ASHRAE.

Please contact Kumar Kumaran (613-993-9611) for further details on this project.

Moisture in Exterior Wall Systems (MEWS)

There is no doubt that the effects of moisture from various sources on exterior wall systems can be a major headache for designers and builders. IRC is now in its final year of this multi-year consortium research project that aims to develop design considerations for wall systems for various climate conditions and locations throughout North America. In December 2001, the Steering Committee reviewed the final outputs of the MEWS research and reports will follow soon.

This project will help designers and builders to better manage moisture in exterior walls. The partners in this project include other government agencies, industry associations and companies in both Canada and the United States.

For more information, contact Kumar Kumaran (613-993-9611).
**Working with Masonry**

This long-term IRC project investigating the retrofitting of masonry walls is now focusing on test methods for assessing the durability of masonry – in particular, the frost resistance of clay bricks and the weaker repointing mortars that were often used for older masonry.

The working group for repointing mortars, consisting of designers, restoration specialists, manufacturers, masons and researchers, continues to gather and share information. Ultimately, this work will provide guidance on best materials and practices for renovating older homes. Interested home builders can refer to the IRC masonry web site for details (http://www.cisti.nrc.ca/irc/bes/masonry/).

For additional information, contact Paul Maurenbrecher (613-993-0073) or Madeleine Rousseau (613-993-3938).

**Rooftop Garden Benefits**

It is clear that rooftop gardens – on apartment buildings, for example – have the potential to reduce both urban heat island effects and storm water runoff. They can also have other benefits such as adding urban green spaces and increasing property values.

Because a major barrier to the widespread adoption of rooftop gardens in Canada is a lack of technical information on benefits and durability in a Canadian context, IRC and its partners launched a two-year research project in 2000 that will combine field study and computer simulation.

At its Ottawa campus, IRC has constructed a rooftop wild flower garden over a modified bituminous roof system. Temperature, relative humidity, heat flux, solar reflectance, soil moisture content and storm water run-off data are being gathered to provide a field reference for validating a computer model. Climate data from all regions of Canada will eventually be incorporated into the model to predict the success and benefits of rooftop gardens across the country.

For information, contact Karen Liu (613-993-4584).

**Durability of High-Performance Glazing Units**

IRC has made many advances to improve the durability and performance of windows to the benefit of both homeowners and home builders. For example, IRC developed the argon gas test method adopted by CGSB (now the Canadian standard). Also, IRC developed a high-voltage discharge method that manufacturers use in their plants to verify that the correct amount of gas has been inserted between the panes. This is an important procedure for ensuring windows perform up to their specifications.

IRC is further advancing window technology by examining other insulating gases. Another initiative is underway to characterize the performance of the sealant that retains the insulating gas between the panes. Over time, the gas dissipates through the sealant. This research will help manufacturers develop sealants that reduce leakage, ensuring that windows perform better for a longer period of time.

Finally, IRC is investigating warm-edge technology for windows. Presently, windows employ a metal spacer to keep the panes separated. The metal acts as a thermal bridge that reduces the thermal efficiency around the edge. This affects heat loss but also leads to condensation and a shortened life span of the window unit. IRC is investigating the use of non-metal spacers to improve window performance.

For further information, contact Hakim Elmahdy (613-993-9752).
THE INDOOR ENVIRONMENT

Canadian homeowners are increasingly aware of how key elements of the indoor environment like lighting, acoustics, temperature, ventilation and air quality affect their well-being: their comfort, health and satisfaction. IRC devotes considerable effort to developing knowledge, tools and techniques for designing and operating healthy, efficient indoor spaces in residential buildings.

Material Emissions and Indoor Air Quality

House designers, builders and owners are increasingly inquisitive about the effect of emissions from construction materials on indoor air quality (IAQ). One joint project between NRCan, CMHC and IRC is intended to assess how materials such as carpets and paint used in a new house can lead to emissions and affect indoor air quality. This research will help develop and refine computer models to predict such emissions, as well as evaluate the effectiveness of various materials selected for use in R-2000 houses. Significantly, this is the first research being conducted by the Canadian Centre for Housing Technology (CCHT).

To date, researchers have selected and tested samples from the construction materials of the two CCHT research houses at various construction stages to determine their emission characteristics. They have monitored various physical and environmental parameters such as air change rate, air temperature, relative humidity and concentrations of total volatile organic compounds, and compared the results against computer simulations to predict the indoor air quality.

For information on this key research into factors affecting residents of new homes, contact Jim Reardon (613-993-9700), Bob Magee (613-993-9631) or John Shaw (613-993-9702).

Indoor Air Quality Monitoring

The recently completed project on Material Emissions and Indoor Air Quality Modeling is now entering its second phase, guided and supported by a consortium of government members including Public Works and Government Services Canada, Natural Resources Canada, Canadian Mortgage and Housing Corporation, Health Canada, and NRC. In this second phase, the research is directed towards:

1. Determining a target list of volatile organic compounds (VOCs) including those which are known to exist indoors, those which are known to be emitted from various materials, and, especially, those known to have health effects,

2. Determining the ranges of variation for the emissions from selected materials, which may result from material variability or environmental influences,

3. Expanding the database to include a total of up to 70 materials and re-analysing the existing data to cover as many VOCs on the new target list as possible, and

4. Refining the IAQ simulation program to make it more user friendly.

An important addition to the project in this phase is a Health and End User Advisory Committee, which will provide much needed advice on the health aspects of the research.

For more information, contact Thomas Biesenthal (613-993-9711), Doyun Won (613-993-9538) or John Shaw (613-993-9702).
Ventilation and Mechanical Plants for High-Rise Apartment Buildings

IRC has joined with CMHC to examine how air moves in high-rise residential buildings – in particular, how air leakage and mechanical ventilation interact to affect air movement patterns and energy leakage in these buildings. This research should lead to better design, with more realistic heating and cooling loads, and thereby more appropriately sized mechanical plants for these large buildings. To date, all field experiments have been completed and a final report is being prepared.

For further information, contact Jim Reardon (613-993-9700), Doyun Won (613-993-9538) or John Shaw (613-993-9702).

Flanking Sound Transmission in Multi-Family Dwellings

The suppression of sound transmission from one room to another or from one living unit to another is important to building occupants and a key consideration for home builders. IRC is now in Phase II of this major sound transmission study. Phase II focuses on sound transmission through the structural connections and builds on the findings of Phase I, which focused on the acoustic properties of fire stops at floor/wall junctions.

It is widely recognized that an “apparent” or “as-installed” sound isolation greater than STC 50 is required to satisfy the majority of occupants. Even though the assemblies should be performing acoustically, structural transmission of vibration may compromise overall acoustic performance. Therefore, suitable designs are required not just for the walls and floors separating dwelling spaces, but also for the complete connected system.

IRC has evaluated a series of connected wall and floor assemblies using a special laboratory mock-up to assess sound isolation for the complete system. The project focuses on wood-frame assemblies that satisfy the fire resistance and structural integrity requirements in building codes. In addition to characterizing a series of base constructions, the research has also developed a set of modifications for optimizing sound isolation, some of which are suitable for retrofit.

This IRC project has been conducted in collaboration with CMHC, Forintek Canada Corporation, Marriott International, TrusJoist MacMillan, Owens Corning Fiberglas, and USG Corp. Final reports will be available in mid-2002.

For further information, contact Trevor Nightingale (613-993-0102).

Fire Resistance and Sound Performance of Wall Assemblies - Phase II

IRC has evaluated many different types of wall assemblies to assess their combined sound transmission and fire resistance characteristics. This project focused on steel-frame and wood-frame load-bearing walls with shear membranes. The results from this project, together with findings from a preceding project completed in 1995, provide a database for consistent comparisons of the performance of gypsum board walls.

The project was conducted by IRC in collaboration with the Canadian Home Builders’ Association, Canadian Sheet Steel Building Institute, Canadian Steel Construction Council, Canadian Wood Council, Cellulose Insulation Manufacturers Association of Canada, Forintek Canada, Gypsum Manufacturers of Canada, Owens Corning, and Roxul Inc.

The fire resistance study has been documented in IRC Internal Reports: IR-729 and IR-806 for wood-framed assemblies, and IR-833 for steel-framed assemblies. The corresponding details for sound transmission are summarized in report IR-832. This information will assist builders and regulators to provide suitable floor and wall assemblies, particularly for multi-family dwellings.

A proposal for updating Table A-9.10.3.1.A in the NBC Part 9, Appendix A, to include the results of this study is in preparation.

For further information, contact Venkatesh Kodur (Fire) (613-993-9729) or Trevor Nightingale (Acoustics) (613) 993-0102.
URBAN INFRASTRUCTURE REHABILITATION

IRC examines how municipal infrastructure deteriorates in order to develop cost-effective technologies for construction, evaluation and repair of such assets as roads, buried utilities and concrete. This helps the construction industry determine how and when to repair, replace or rehabilitate facilities, taking into account past performance, expected performance and cost. Currently, the emphasis is on developing cost-effective rehabilitation technologies and asset management systems.

Watermains: Rehabilitation and Protection

IRC’s project to develop long-term and short-term planning tools for renewing water-distribution systems is progressing. It will soon include a module to enable decisions based on individual water mains in addition to the tools addressing water main groups.

These tools will help engineers and planners to determine, for each watermain in the distribution network, the best rehabilitation method and the optimal timing for the work. The ability to plan more effectively will not only save on municipal costs, but will minimize disruptions and inconveniences to homeowners and businesses. The information will also be useful to those home builders who are responsible for constructing subdivision watermain distribution networks, or repairing watermain breaks near homes.

Another IRC consortium of 12 water utilities and one manufacturer is supporting a three-year study into the effectiveness of cathodic protection in watermains. This project, entering its third year, will provide tools to make better decisions regarding where and when cathodic protection programs should be implemented by water utilities, to reduce total life cycle costs of water mains and improve the quality of service.

Further information about these watermain projects can be obtained from Yehuda Kleiner (613-993-3805).

Update on Canadian Centre for Housing Technology

Capacity Building

During the summer of 2001, several important changes were introduced in the test and reference houses at the Canadian Centre for Housing Technology (CCHT). The changes provide greater flexibility to serve a wider array of clients as well as the ability to collect additional data.

In developing innovative technologies, manufacturers may not be able to arrive at high-efficiencies with their first prototypes and the benchmark may be set unnecessarily high. Hence, each house has been equipped with a mid-efficiency gas-fired forced-air furnace to give manufacturers a choice of benchmark. The switch from high- to mid-efficiency furnaces is relatively straightforward and the houses have been successfully benchmarked in both configuration.

Furnaces have also been positioned so as to have a 106-mm straight run of duct right off the heat exchanger to allow for precise measurements of air flows across the duct section. The air flow station is operated by NRCan staff who also have installed additional thermocouples and sensors to monitor variables such as temperature differences across the heat exchanger and combustion efficiency.

In anticipation of working with manufacturers of co-generation equipment such as fuel cells, changes have been made to the power supply in each house. The main feed has been split so that the house can be off-grid and powered by a co-generation system while the outlets for the “humans” and the control room remain on-grid. Each house has also been equipped with a high-end power quality monitoring device.

Recent benchmarking in heating mode showed the houses to be identical in performance. Evaluations of advanced integrated mechanical systems under NRCan’s eKoComfort program are continuing through the winter of 2001/02 at CCHT.

Note: The Canadian Centre for Housing Technology is a partnership between IRC, CMHC and NRCan and is located on IRC grounds in Ottawa.
DISCUSSION PAPER ON INNOVATION IN THE HOUSING SECTOR

An Opportunity to Present your Views

The Institute for Research in Construction (IRC) and the Canadian Home Builders’ Association (CHBA), in cooperation with Canada Mortgage and Housing Corporation (CMHC) and Natural Resources Canada (NRCan) are examining innovation in the housing industry with a view to fostering more innovation. As part of that process, they have commissioned the preparation of a discussion paper. This paper focuses exclusively on the residential sector, and more specifically on that part of the residential sector that builds under Part 9 of the National Building Code. The paper has the following main objectives:

• To present an overview of the innovation “system” in the housing industry, i.e., an explanation of innovation and of the factors that affect it.

• To identify possible actions by a number of players to foster more innovation in the housing industry.

The paper is being circulated throughout the housing industry to solicit opinions about innovation in housing. The responses received will assist in the development of policies or actions to foster more innovation in the industry.

The views presented in the paper are based on a review of previous publications and reports on the subject, interviews with numerous people in the housing sector, and expert opinions.

The paper was developed as a follow-up to two innovation forums sponsored by IRC in June 2001. The forums, one international in scope and one Canadian, reviewed innovation-related studies that had been completed in 15 countries and solicited ideas on actions that might be taken to foster innovation in the Canadian construction industry. These forums addressed only the institutional-commercial-industrial (ICI) sector. Recognizing that the ICI sector has characteristics quite different from those of the residential sector, IRC and CHBA decided that any examination of innovation in housing should be treated separately. Hence, a decision was made to develop a discussion paper focusing on housing alone.

The 30-page paper is organized as follows:

• Introduction
• Executive Summary
• Explanation of Innovation and Related Concepts
• Characteristics of the Housing Sector Relevant to Innovation
• Overview of Factors Related to Innovation in Housing
• Review of and Recommendations on Accelerators to Innovation
• Review of and Recommendations on Barriers to Innovation
• Review of and Recommendations on Contingent Factors
• Other Strategic Variables
• Review of and Recommendations on Regulations
• General Conclusion

The full text of the discussion paper can be found on the IRC web site at www.nrc.ca/irc.

The paper was written by Linden Holmen, currently the Chair of the Technical Research Committee of CHBA. Mr. Holmen has 30 years of experience in the public and private sectors.
PUBLICATIONS AND ADDITIONAL SOURCES OF INFORMATION

National Model Construction Codes and Guides

The National Construction Codes and supplementary Guides (http://www.cnrc.ca/irc/catalogue/codes.html) are used as models for virtually all building and fire regulations in Canada. These tools for safe, efficient construction are indispensable for home builders seeking to be at the leading edge of their profession. The following Codes and Guides are the most helpful to home construction industry practitioners:

- National Fire Code of Canada 1995
- National Plumbing Code of Canada 1995
- National Housing Code of Canada 1998 and Illustrated Guide

Construction Innovation Newsletter

Information about current and recent IRC activities, many of them of direct interest to home builders, is available in the popular newsletter, Construction Innovation, which can be found at: http://www.nrc.ca/irc/newsletter/toc.html

Construction Technology Updates

Construction Technology Updates (CTU’s) are the main source of IRC information for builders (www.nrc.ca/irc/catalogue.ctu.html). The CTU’s are concise and easy-to-read publications of four to six pages each. Those that are most relevant to builders are listed below.

Sound Control

No. 1 Control of Sound Transmission through Gypsum Board Walls
No. 13 Controlling Sound Transmission through Concrete Block Walls
No. 16 Sound Isolation and Fire Resistance of Assemblies with Fire Stops
No. 25 Controlling the Transmission of Airborne Sound through Floors
No. 27 Effect of Electrical Outlet Boxes on Sound Isolation of Gypsum Board Walls
No. 35 Controlling the Transmission of Impact Sound through Floors
No. 50 Specifying Acoustical Criteria for Buildings

Fire Safety

No. 2 Fire Resistance of Gypsum Board Wall Assemblies
No. 16 Sound Isolation and Fire Resistance of Assemblies with Fire Stops
No. 20 Fire Resistance of Floor Assemblies in Multi-Family Dwellings
Concrete and Masonry
No. 7 Corrosion of Metal Ties in Masonry Cladding
No. 8 Six Axioms for Building Durable Concrete Structures
No. 24 Surface Preparation of the Concrete Substrate
No. 44 Curling of Concrete Slabs on Grade

Building Envelopes
No. 9 Evolution of Wall Design for Controlling Rain Penetration
No. 17 Pressure Equalization in Rainscreen Wall Systems
No. 23 Water-Shedding Details Improve Masonry Performance
No. 28 Performance Issues with Muntin Bars in Sealed Insulating Glass Units
No. 34 Designing Exterior Walls According to the Rainscreen Principle
No. 36 Performance of Thermal Insulation on the Exterior of Basement Walls
No. 41 Low-Permeance Materials in Building Envelopes
No. 46 A Method for Evaluating Air Barrier Systems and Materials

Ventilation
No. 14 Why Houses Need Mechanical Ventilation Systems
No. 15 Current Approaches for Mechanical Ventilation of Houses

Structural Performance
No. 22 Control of Floor Vibration
No. 45 Ensuring Good Seismic Performance with Platform-Frame Wood Housing

Updates are $10.00 each and are available by calling 1-800-672-7990 (local and U.S. calls 1-613-993-2463).

Archived Publications

Much of the following archived information is relevant to builders and is available on the publications section of the IRC website http://www.cisti.nrc.ca/irc/publications.html

• Canadian Building Digests – a collection of 250 4-page concise summaries containing background information and practical guidelines on virtually every aspect of building design and construction in Canada, published between 1960 and 1990.
• Construction Practice – A collection of articles by IRC researchers previously published in construction-related magazines.
• Registry of Product Evaluations from IRC’s Canadian Construction Materials Centre.

IRC Web Site

The general IRC web site (http://www.cisti.nrc.ca/irc/irccontents.html) contains much other information of interest to builders.